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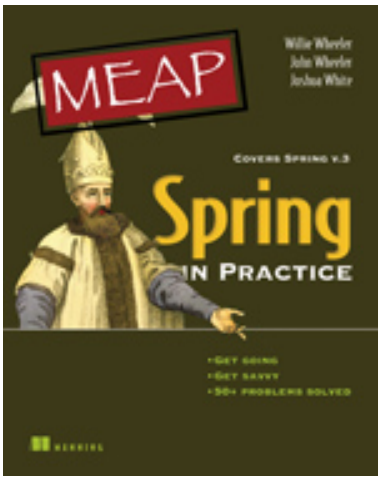

Spring in Practice
By Willie Wheeler, John Wheeler, and Joshua White

In an enterprise of any size, there may be multiple system monitoring tools, ticketing systems, and knowledge management systems. There are many reasons why the systems in an environment might be a big jumbled mess. Despite the difficulty, the need for systems integration is very much alive and well. In this article, based on chapter 13 of Spring in Practice, the authors show you how to implement a ticketing system in such a way that it's easy to integrate it with other systems.

Recipe: Creating an Integration-Ready Ticketing System Shell

Key technologies

Spring Integration, Spring Web MVC

Background

This recipe is part of a series of recipes that incrementally builds an integrated technical support ticketing system to support an external-facing, internally-developed university portal.

Problem

You want to implement a ticketing system in such a way that it's easy to integrate it with other systems, including self-service ticketing and external ticketing systems used by escalated support teams.

Solution

We're going to use Spring Integration as a basis for our integration efforts. In this recipe, we're not going to do any integrations—we're just going to implement a basic ticketing shell against a simple message bus. That way it will be easier to perform the systems integrations.

Figure 1 shows what we're going to build in this recipe.

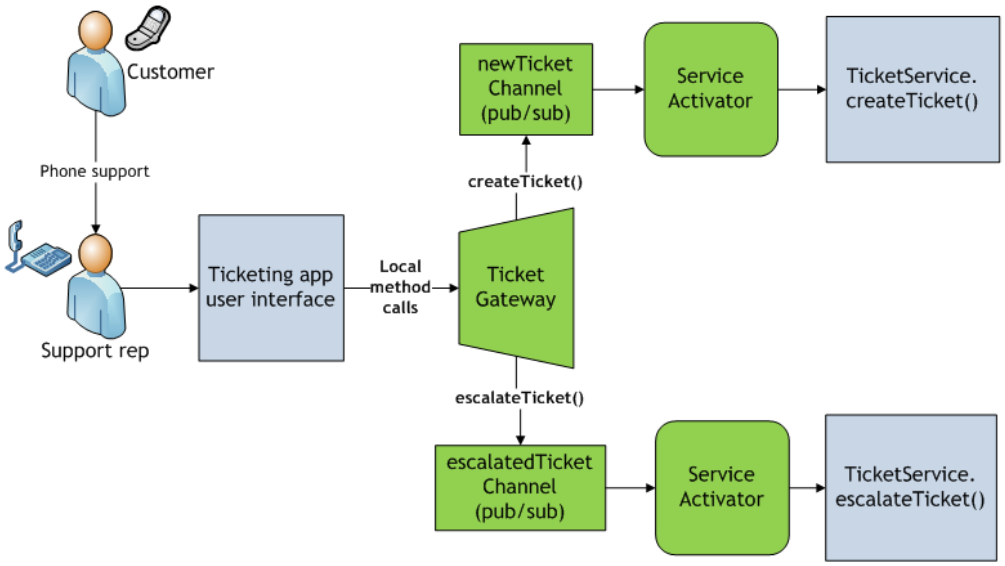

Figure 1 The basic functionality of our sample tech support ticketing system: creating and escalating tickets.

Let's go over figure 1 in some detail since this is our first exposure to Spring Integration. We'll revisit some of these points later on in our application context configuration, but it will help to begin our discussion with a lay of the land.

First, we're developing an application for internal tech support staff. Reps might conceivably use the system for several reasons, but we'll focus on two use cases:

- A student or faculty user calls the help desk and reports a portal issue. A rep at the help desk uses the ticketing system to create a new ticket on the user's behalf.
- If a ticket looks like a development issue, then the rep uses the ticketing system to escalate the ticket to the portal development team.

In figure 1, we can see the relationship between the customer, the rep, and the ticketing system. You may notice something a little unusual. Normally, we'd just inject our `TicketService` directly into the UI (for example, into any Spring Web MVC controller that wants to use it), and then the UI would call service methods such as `createTicket()` and `escalateTicket()` as needed. But we're not doing that here. Instead, we've inserted a bunch of messaging components—collectively forming a message bus—between the UI and services. The reason is that we want to define ticket creation and ticket escalation as standardized, bus-accessible services, and the first step to doing that is to create the bus and attach the services to the bus. Then our ticketing system UI accesses those services through the bus.

The `TicketGateway` interface hides the details of the messaging system away from UI. This allows the UI to use the bus without having to know anything about messaging concepts such as channels and messages. We'll see in listing 5 that the `TicketGateway` interface is expressed entirely in ticketing domain terms.

The message flow out of the `TicketGateway` depends on whether the rep is creating or escalating a ticket. Let's take the ticket creation fork first. When the rep creates a ticket, the gateway will wrap the ticket in an `org.springframework.integration.core.Message` and drop the `Message` onto the `newTicketChannel`. The reason for wrapping the ticket is that we're in the messaging domain now, and the messaging components making up the messaging system need to know how to talk to one another; hence `Message`s. Each `Message` has a payload (in the present case, the ticket is the payload) and an arbitrary set of headers that can be used for routing and processing.

Our `newTicketChannel` is a publish/subscribe (pub/sub) channel. (The underlying class is `PublishSubscribeChannel`.) Any number of endpoints can subscribe to a pub/sub channel and, when messages appear on the channel, all subscribed endpoints receive it. This stands in contrast to direct channels, which allow only a single receiving endpoint.[1]

The subscriber essentially is our ticket creation service (as represented by `TicketService.createTicket()`). We wrap the ticket creation service with a service activator endpoint, which allows us to access the service from the messaging system by adapting the service interface to the messaging endpoint interface.

Entirely analogous comments apply to the ticket escalation fork, so we won't work through all the gory details. Instead let's start looking at some code.

Listing 1 shows the domain object for tickets.

Listing 1 Ticket.java, a domain object representing a simple ticket

```
package ticketing.model;

import java.util.Date;

public class Ticket {
    private String custName;
    private String custEmail;
    private String issueCategory;
    private String issueDesc;
    private Date dateCreated;

    ... getters and setters for the above,
        along with a descriptive toString() method ...
}
```

Our `Ticket` class isn't anything special, but it will do the job we need it to do.

We'll now build our equally basic service tier. Our goal is to keep it focused on business logic and, in particular, free from integration code. This offers greater flexibility during integration efforts because we can configure and aggregate services as we wish.

Building the service tier

In listing 2 we have a basic ticket service interface.

Listing 2 TicketService.java service interface

```
package ticketing.service;

import ticketing.model.Ticket;

public interface TicketService {
    void createTicket(Ticket ticket);
    void escalateTicket(Ticket ticket);
    Ticket findTicket(long id);
}
```

Besides the `createTicket()` and `escalateTicket()` methods, we have a `findTicket()` method that we can use to look up tickets prior to escalating or doing other things with them.

Listing 3 presents a dummy implementation of our `TicketService` interface. Take a look and we'll discuss it afterward.

Listing 3 TicketServiceImpl.java service implementation

```
package ticketing.service;

import java.util.Date;
import java.util.logging.Logger;
import org.springframework.stereotype.Service;
```

[1] Pub/sub and direct channels are roughly analogous to JMS topics and queues, respectively.

```
import ticketing.model.Ticket;

@Service("ticketService")
public class TicketServiceImpl implements TicketService {
    private static Logger log =
        Logger.getLogger(Logger.GLOBAL_LOGGER_NAME);

    public void createTicket(Ticket ticket) {
        log.info("TicketService is creating ticket...");
    }

    public void escalateTicket(Ticket ticket) {
        log.info("TicketService is escalating ticket...");
    }

    public Ticket findTicket(long id) {                                    #1
        Ticket ticket = new Ticket();
        ticket.setCustomerName("Frank Black");
        ticket.setCustomerEmail("frankblack@pixies.com");
        ticket.setIssueCategory("library");
        ticket.setIssueDescription("Can't download MP3s in the library.");
        ticket.setDateCreated(new Date());
        return ticket;
    }
}
```

#1 Returns dummy ticket

The `createTicket()` and `escalateTicket()` methods are just placeholder methods. In a typical implementation, `createTicket()` would probably save the ticket in a database, and it might even send out a confirmation email. In our case, it would be fine to save the ticket in the database, but we would *not* send out a confirmation because we consider sending confirmation emails a good candidate for a reusable service.[2]

Similarly, a typical `escalateTicket()` implementation might update the ticket with a note concerning the escalation, save the ticket, and then call a web service that creates a new ticket in the escalation ticketing system. But, once again, that ticket creation is a good service candidate, so we shouldn't include it inside the `escalateTicket()` method.

These considerations aren't to say that we don't want to send confirmation emails and create escalated tickets. We do. We just want to handle the more general definition of the ticket creation and ticket escalation processes in the integration layer instead of inside `TicketServiceImpl` itself. That allows us to achieve the integration we want without inflexibly coupling `TicketServiceImpl` to external systems.

Finally, our `findTicket()` method (#1) simply returns a dummy ticket. We won't do anything with this ticket other than escalate it; in particular, we won't send `frankblack@pixies.com` any confirmation emails.

Listing 4 shows our `applicationContext.xml`. All it does is find and create the `TicketServiceImpl` bean, but stay tuned; we'll look at another application context file shortly.

Listing 4 /WEB-INF/applicationContext.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:context="http://www.springframework.org/schema/context"
    xmlns:p="http://www.springframework.org/schema/p"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
        http://www.springframework.org/schema/beans/spring-beans-2.5.xsd
        http://www.springframework.org/schema/context
        http://www.springframework.org/schema/context/
            [CA]spring-context-2.5.xsd">

    <context:component-scan base-package="ticketing.service" />
</beans>
```

[2] Indeed, we wrote exactly this type of functionality in chapter 4 for new user registrations.

That's it for the service tier. Clearly we've met our goal of avoiding integration logic in our service bean. We'll turn now to the integration tier, where the integration concern lives.

Buliding the integration tier

We've already mentioned that we're just going to set the integration stage in this recipe. Listing 5 presents a gateway interface into our messaging system.

Listing 5 TicketGateway.java gateway interface hides messaging from the app

```
package ticketing.integration;

import org.springframework.integration.annotation.Gateway;

import ticketing.model.Ticket;

public interface TicketGateway {

    @Gateway(requestChannel = "newTicketChannel")                    #1
    void createTicket(Ticket ticket);

    @Gateway(requestChannel = "escalatedTicketChannel")
    void escalateTicket(Ticket ticket);
}
```

#1 A gateway method

The purpose of this interface is to hide messaging concepts away from applications that want to use the messaging system. Here that means defining the interface in terms of `Ticket`s rather than `Message`s.

While it would be possible to implement the interface manually, we'll see in a bit how to use Spring Integration to generate dynamic proxies for the interface. We use the optional `@Gateway` annotation to assist with that. The proxy will wrap the `Ticket` with a `Message`. (That is, the `Ticket` will be the `Message` payload.) The `requestChannel` element specifies where the proxy should drop the `Message`. So at [#1] we're saying that when an app calls `createTicket()`, we want to place a `Message` containing that `Ticket` on the `newTicketChannel`. Table 1 shows the options for the `@Gateway` annotation.

Table 1 @Gateway annotation and available elements

Element	Description
`requestChannel`	Target channel for request messages (messages wrapping the argument)
`requestTimeout`	Timeout for sending messages on the `requestChannel`
`replyChannel`	Source channel for reply messages (messages wrapping the return value)
`replyTimeout`	Timeout for receiving messages on the `replyChannel`

In listing 5 our methods are request-only (no reply) since their return values are void, so we don't specify a `replyChannel`.

Listing 6 is a Spring application context configuration that defines our simple message bus.

Listing 6 /WEB-INF/applicationContext-integration.xml message bus definition

```
<?xml version="1.0" encoding="UTF-8"?>
<beans:beans xmlns="http://www.springframework.org/schema/integration"    #1
    xmlns:beans="http://www.springframework.org/schema/beans"             #2
    xmlns:context="http://www.springframework.org/schema/context"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
        http://www.springframework.org/schema/beans/spring-beans-2.5.xsd
        http://www.springframework.org/schema/context
        http://www.springframework.org/schema/context/
            [CA]spring-context-2.5.xsd
```

```
        http://www.springframework.org/schema/integration
        http://www.springframework.org/schema/integration/
            [CA]spring-integration-1.0.xsd">                              #3

    <gateway id="ticketGateway"
        service-interface="ticketing.integration.TicketGateway" />    #4

    <publish-subscribe-channel id="newTicketChannel" />               #5

    <service-activator
        input-channel="newTicketChannel"
        ref="ticketService"
        method="createTicket" />                                      #6

    <publish-subscribe-channel id="escalatedTicketChannel" />

    <service-activator
        input-channel="escalatedTicketChannel"
        ref="ticketService"
        method="escalateTicket" />

</beans:beans>
```

#1 Sets default namespace
#2 Explicit beans NS prefix
#3 SI schema location
#4 Gateway definition
#5 Pub/sub channel
#6 Service activator

We're using a separate application context configuration to define our message bus as this approach helps keep the messaging concern separate. We begin by making the Spring Integration namespace the default namespace (#1), which saves a few keystrokes. Accordingly, we define an explicit namespace prefix for the `beans` namespace (#2). Note also the schema location for the Spring Integration namespace (#3).

Refer back to figure 1 to get a visual sense of what we're building here. First, we use the `<gateway>` element (#4) to define the `TicketGateway` dynamic proxy that we discussed above. Besides the `service-interface` attribute specifying the gateway interface, `<gateway>` supports several attributes that describe the gateway's interaction with its request and reply channels, including `default-request-channel`, `default-request-timeout`, `default-reply-channel` and `default-reply-timeout`, each having the semantics you'd expect given what we laid out in table 1. We aren't using the attributes here, however, having opted instead to specify the request channel using the `@Gateway` annotation as we saw in listing 5.

At #5, we define a publish/subscribe channel called `newTicketChannel`. Recall that our gateway will place a `Message` on the `newTicketChannel` whenever somebody calls `createTicket()` on the `TicketGateway`. Note also that `newTicketChannel` will be a focal point for the integrations we do in recipes 3 and 4 when we add support for ticket creation via inbound web forms and e-mails, respectively. Because it's a pub/sub channel, it can have multiple subscribers, and each subscriber receives a copy of any message that appears on the channel.

Finally, at #6, we have an endpoint called a *service activator*. The purpose of a service activator is to adapt service methods to the message bus. In the general case, a service method has an argument and a return value, both of which need to be mapped to messages in order to play nicely with the bus. That's where the service activator comes in. It wraps a service method such that payloads are extracted from incoming messages (messages arriving on the `input-channel`) and passed into the service method. The return value is wrapped with a new message and dropped onto the `output-channel`. In this case, the `TicketService.createTicket()` method doesn't have a return value, so there's no `output-channel` definition.

The same statements apply to the service activator for the `escalateTicket()` method.

Believe it or not, that's all there is to the integration tier for now. So far, we haven't done anything that we couldn't have done just as easily (well, OK, more easily) without Spring Integration, but the idea is that, as we start hooking up external dependencies, the value of separating business code from integration code will grow.

Let's knock out the web tier.

Building the web tier

We're going to use Spring Web MVC for the web tier. Listing 7 shows how we access our integration tier from our controller.

Listing 7 TicketController.java, a Spring Web MVC @Controller

```
package ticketing.web;

import java.util.Date;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Controller;
import org.springframework.ui.Model;
import org.springframework.web.bind.annotation.*;
import ticketing.integration.TicketGateway;
import ticketing.model.Ticket;
import ticketing.service.TicketService;

@Controller
public class TicketController {

    @Autowired
    private TicketService ticketService;                                    #1

    @Autowired
    private TicketGateway ticketGateway;                                    #2

    @RequestMapping(method = RequestMethod.GET)
    public void create(Model model) {
        model.addAttribute(new Ticket());
    }

    @RequestMapping(method = RequestMethod.POST)
    public String create(Ticket ticket) {
        ticket.setDateCreated(new Date());
        ticketGateway.createTicket(ticket);                                 #3
        return "ticket/ticketcreated";
    }

    @RequestMapping(method = RequestMethod.GET)
    public void escalate() { }

    @RequestMapping(method = RequestMethod.POST)
    public String escalate(@RequestParam("id") long ticketId) {
        Ticket ticket = ticketService.findTicket(ticketId);                 #4
        ticketGateway.escalateTicket(ticket);                               #5
        return "ticket/ticketescalated";
    }
}
```

#1 Service dependency
#2 Gateway dependency
#3 Creates ticket using gateway
#4 Normal service lookup
#5 Escalates ticket using gateway

The `TicketController` depends on both the `TicketService` (#1) and the `TicketGateway` (#2). The `POST` version of our `create()` method (#3) uses the gateway to perform the ticket creation. While we could certainly call `createTicket()` directly, doing so would mean that we'd have to put any future integration code inside the service itself instead of isolating it and wiring it up to the bus. So we use the gateway instead. Notice also that the gateway has indeed allowed us to use the message bus without referencing messaging constructs like channels and messages.

In the `POST` version of our `escalate()` method, we use the service and the gateway together. We use the service to look up the `Ticket` (#4) and then pass the `Ticket` along to the gateway (#5) so the gateway can wrap it with a `Message` and put it on the bus.

Our simple app has four JSPs. Two of them are just "thank you" pages, so we'll ignore those here (check the code download). The other two are forms for ticket creation and escalation. First, listing 8 presents the primary part of the ticket creation form.

Listing 8 /WEB-INF/jsp/ticket/create.jsp form for creating tickets

```
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form" %>

...
```

```
<form:form modelAttribute="ticket">
    Customer name:<br />
    <form:input path="customerName" /><br /><br />

    Customer e-mail address:<br />
    <form:input path="customerEmail" /><br /><br />

    Issue category:<br />
    <form:select path="issueCategory">
        <form:option value="classroom">Classroom issue</form:option>
        <form:option value="library">Library issue</form:option>
        <form:option value="library">Account issue</form:option>
        <form:option value="other">Other issue</form:option>
    </form:select><br /><br />

    Issue description:<br />
    <form:textarea path="issueDescription" rows="8" cols="80" />
    <br /><br />

    <input type="submit" value="Submit"></input>
</form:form>

...
```

Listing 9 shows a ticket escalation form snippet. We've hardcoded a fake ID into the form. You may have noticed in listing 3 that the actual ID doesn't matter.

Listing 9 /WEB-INF/jsp/ticket/escalate.jsp form for escalating tickets

```
...

<form action="escalate" method="post">
    Escalate which ticket ID?<br />
    <input type="text" name="id" value="333">
    <input type="submit" value="Submit"></input>
</form>

...
```

Listing 10 contains a completely pedestrian `DispatcherServlet` application context.

Listing 10 /WEB-INF/main-servlet.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:context="http://www.springframework.org/schema/context"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
        http://www.springframework.org/schema/beans/spring-beans-2.5.xsd
        http://www.springframework.org/schema/context
        http://www.springframework.org/schema/context/
            [CA]spring-context-2.5.xsd">

    <context:component-scan base-package="ticketing.web" />

    <bean class="org.springframework.web.servlet.mvc.support.
        [CA]ControllerClassNameHandlerMapping" />

    <bean class="org.springframework.web.servlet.view.
        [CA]InternalResourceViewResolver"
        p:prefix="/WEB-INF/jsp/"
        p:suffix=".jsp" />
</beans>
```

Finally, listing 11 is just a standard `web.xml` configuration, which we're including just for completeness.

Listing 11 /WEB-INF/web.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns="http://java.sun.com/xml/ns/javaee"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
        http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
    version="2.5">

    <context-param>
        <param-name>contextConfigLocation</param-name>
        <param-value>
            /WEB-INF/applicationContext.xml
            /WEB-INF/applicationContext-integration.xml
        </param-value>
    </context-param>
    <listener>
        <listener-class>
            org.springframework.web.context.ContextLoaderListener
        </listener-class>
    </listener>
    <servlet>
        <servlet-name>main</servlet-name>
        <servlet-class>
            org.springframework.web.servlet.DispatcherServlet
        </servlet-class>
    </servlet>
    <servlet-mapping>
        <servlet-name>main</servlet-name>
        <url-pattern>/main/*</url-pattern>
    </servlet-mapping>
</web-app>
```

We should now have a working Spring Integration app. Assuming you have the Maven code download, enter `http://localhost:8080/ticketing/main/ticket/create` into your browser. You should see a web form called **Create a trouble ticket**. When you submit the form, you should see that `TicketService.createTicket()` generates a console message that says

```
INFO: TicketService is creating ticket...
```

If so, pat yourself on the back, because you've made it through this recipe.

Discussion

This recipe, though lengthy, established an integration-ready web application. We learned how to invoke service beans using a service bus.

One major advantage of building an application using a message bus is that it makes integration with other applications simpler. The reason is that Spring Integration provides channel adapters for pulling several different kinds of external channel into the bus infrastructure. External systems can communicate with our ticketing system over those external channels. So, even though we haven't yet performed any actual integration, we've created a bus that will serve as a solid foundation once you start doing the integrations.

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